

What we claim is:

1. A structure for use in interconnections on an electronic device comprising:
a dielectric layer having a substantially planar upper surface and having a pattern of recesses therein,
the recesses having a width at the upper surface less than one micrometer,
the recesses filled with continuous electroplated metal from a bath containing additives, wherein the additives cause the plating rate to increase with depth along the sidewalls of a recess and avoid seam and/or void formation in the recesses; and
wherein the conductor material comprises copper.
2. The structure of claim 1 wherein the recesses have a depth to width ratio equal to or greater than 1.
3. The structure of claim 1 wherein the recesses have a conductive layer on the recesses on said dielectric layer to serve as a plating base.
4. The structure of claim 1 further including a metal liner between the conductive layer and the dielectric layer in the recesses.
5. The structure of claim 1 wherein the copper includes small amounts of a material in said copper selected from the group consisting of C (less than 2 weight percent), O (less than 1 weight percent), N (less than 1 weight percent), S (less than 1 weight percent), and Cl (less than 1 weight percent).
6. The structure of claim 1 wherein the copper includes specific film microstructures including large grain size relative to film thickness and/or randomly oriented grains.
7. The structure of claim 5 wherein the small amounts of material include atoms and/or molecular fragments.
8. The structure of claim 1 wherein the conductor has an activation energy for electromigration equal to or greater than 1.0 eV and further includes specific film microstructures including large grain size relative to film thickness and/or randomly

oriented grains whereby the electromigration behavior is enhanced over non-electroplated copper.

9. The structure of claim 1 wherein the conductor material further includes positive amounts of atoms and/or molecular fragments containing atoms selected from the group consisting of C, O, N, S, and Cl.

10. The structure of claim 9 wherein the electromigration resistance of the copper is enhanced over pure copper.

11. The structure of claim 1 wherein the copper is obtained by electroplating from a plating solution comprising a copper salt, a mineral acid, and one or more additives selected from the group consisting of an organic sulfur compound with water solubilizing groups, a bath-soluble oxygen-containing compound, a bath-soluble polyether compound, or a bath-soluble organic nitrogen compound that may also contain at least one sulfur atom.

12. The structure of claim 11 wherein the plating solution contains small amounts of a chloride ion in the range from 10 to 300 parts per million.

13. The structure of claim 11 wherein the copper salt is cupric sulfate.

14. The structure of claim 11 wherein the mineral acid is sulfuric acid.

15. The structure of claim 11 wherein the organic sulfur compound carries at least one sulfonic group.

16. The structure of claim 11 wherein the organic sulfur compound has at least two sulfur atoms that are vicinal.

17. The structure of claim 16 wherein the organic sulfur compound has at least two sulfur atoms that are vicinal and carries at least one terminal sulfonic group.

18. The structure of claim 11 wherein the organic sulfur compound is selected from the group consisting of mercaptopropane sulfonic acid, thioglycolic acid,

mercaptobenzthiozol-S-propansulfonic acid and ethylenedithiodipropyl sulfonic acid, dithiocarbamic acid, alkali metal salts thereof, and amine salts thereof.

19. The structure of claim 11 wherein the organic sulfur compound has the formula $X-R_1-(S_n)-R_2-SO_3H$ where the R groups are the same or different and contain at least one carbon atom, X is selected from the group consisting of a hydrogen and a sulfonic group, and n is 2-5 inclusive.

20. The structure of claim 11 wherein the oxygen-containing compound is selected from the group consisting of polyethylene glycol, and carboxymethylcellulose.

21. The structure claim 11 wherein said organic nitrogen compound is selected from the group containing pyridines and substituted pyridines, amides, quaternary ammonium salts, imines, phthalocyanines and substituted phthalocyanines, phenazines, and lactams.

22. The structure of claim 11 which comprises a double damascene structure.

23. The structure of claim 1 wherein the additives are polarizing.

24. The structure of claim 1 wherein each of the recesses has a bottom surface and side surfaces intersecting the bottom surface, and wherein the conductor material is deposited on the bottom surface and side surfaces.

25. The structure of claim 24 wherein the bottom surface of each recess is substantially horizontal with respect to a major plane of the substrate.

26. The structure of claim 1 wherein the additives comprise agents for producing bright, level deposits on rough surfaces.

27. The structure claim 1 wherein the additives comprise agents for depositing bright, level, ductile, and low-stress deposits.